Chapter 1

Introduction

Overview

This almanac contains information about current and historical air quality and emissions in California. In addition, forecasted emissions are presented. This document is a reference for anyone interested in air quality and emissions for criteria pollutants (ozone, particulate matter, carbon monoxide, nitrogen dioxide, and sulfur dioxide) and toxic air contaminants (TACs). When using this information, please remember that the air quality and emission values are a snapshot of data at a particular point in time. This edition of the almanac is a year 2007 snapshot of the air quality database and a year 2006 snapshot of the emission inventory database. It is important to keep in mind that emission and air quality data can change over time. For example, emission data may be revised to reflect improved estimation methods, and air quality data may be changed because of corrections or additions of data.

The information in this document is based on data maintained in ARB's emission and air quality databases. The emission and human population estimates are presented at five-year intervals from 1975 to 2020. Data for vehicle miles traveled (VMT) are also provided at five-year increments, beginning with the year 1980. The air quality statistics in this almanac are for the period 1987 to 2006 for ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead. In addition, available 2007 statistics for ozone are included for the five major air basins. Particulate matter (PM) monitoring did not begin until 1988 for PM_{10} and 1999 for $PM_{2.5}$. Therefore, PM_{10} data cover the years 1988 to 2006, and $PM_{2.5}$ data cover the period 1999 through 2006. Air quality monitoring of TACs began in 1983; annual statistics for TACs are available from 1989 onward, and the data for TACs presented in this almanac covers the period 1990 to 2006.

What's New in the 2008 Almanac?

- Added statistics for national ozone and PM nonattainment areas to Chapter 2.
- Updated Air Basin maps in Chapter 4.

All emissions data in this edition are the same as presented in the previous edition. The emissions data will be updated in the 2009 Almanac.

Organization

This document is divided into five chapters and six appendices that include information, maps, graphs, and tabular data. Chapter 1 contains introductory material. Chapters 2 through 4 and Appendices A and B provide information on the most important criteria pollutants for which health-based ambient air quality standards have been established. Chapter 5 and Appendix C provide information on TACs. Appendix D includes information on population and VMT, and Appendix E contains information on natural emissions. In addition to this information, Appendix F provides lists of the figures and tables included in Chapters 1 through 5 along with a glossary of Air Quality and Emissions terminology.

To help the reader navigate the document, a short summary of each chapter and appendix is provided below:

- **Chapter 1** contains introductory material designed to help the reader better understand the remaining chapters. Included is information about data interpretation, emission estimation, air quality monitoring, the State and national standards, web resources, area designations for the State and national standards, and TACs. A list of air pollution contacts is provided at the end of this chapter.

- **Chapter 2** includes current emissions for oxides of nitrogen (NO_x), reactive organic gases (ROG), PM_{10}, $PM_{2.5}$, CO, and ammonia (NH_3) and air quality data for ozone, PM_{10}, $PM_{2.5}$, and CO for each air basin. The emission data also includes lists of the State's highest emitting facilities. Information is included on how air quality in California compares to other parts of the country.

- **Chapter 3** provides historical emission and air quality trends from a statewide perspective. Statewide emission and air quality trends for ozone, PM_{10}, $PM_{2.5}$, CO, lead, and NO_2 are included. In addition, emission trends for oxides of sulfur (SO_x) are included.

- **Chapter 4** provides historical emission and air quality trends for the State's five most populated regions. The pollutants covered are ozone, PM_{10}, $PM_{2.5}$, CO, and NO_2.

- **Chapter 5** contains emission, air quality, and health risk information on TACs for the State as a whole and for five of California's most populated regions. The ten TACs, including diesel PM, that pose the greatest risk in ambient (outdoor) air are covered. The air quality and health risk trends are based on measured ambient data (except for diesel PM, which is based on estimates of ambient concentrations).

- **Appendix A** includes more detailed emission data for NO_x, ROG, PM_{10}, $PM_{2.5}$, and CO organized alphabetically, by air basin. Also included is a list of the highest emitting facilities in each air basin. Air quality data are provided for the criteria pollutants: ozone, PM_{10}, $PM_{2.5}$, CO, NO_2, and SO_2. Data are provided for all air basins and all counties (or county portions) within these air basins.

- **Appendix B** provides emission and air quality information similar to that found in Appendix A, but arranged by pollutant.

- **Appendix C** provides more detailed information on the ten TACs discussed in Chapter 5, including information on the emissions in each county and the air quality and health risk information for the individual sites where TAC concentrations are routinely measured.

- **Appendix D** provides tabulated information on surface area, population, and VMT for the State, each air basin, and for each county (or county portion) within the air basins.

- **Appendix E** provides emission estimates for natural sources, including wildfires, vegetation (biogenic sources), and oil seeps (geogenic sources).
- **Appendix F** provides lists of the figures and tables included in Chapters 1 through 5. A glossary of terms used in the Almanac is provided at the end of this appendix.

This almanac focuses on air emissions and air quality. The California Environmental Protection Agency (CalEPA) has developed a set of indicators to measure California's overall environmental health. The indicators cover all media, not just air, and help us understand the causes of environmental problems, the status of the environment, and the effectiveness of our environmental strategies. The data in this almanac are more detailed indicators of the State's air quality health, and in conjunction with CalEPA's indicators, provide a continuum of information from detailed air quality trends to California's overall environmental health. The most recent set of CalEPA indicators are available at www.oehha.ca.gov/multimedia/epic/.

California Facts and Figures

California is blessed with a wide range of scenery including mountains, valleys, oceans, and deserts. In terms of size, California is larger than many nations in the world today. Of California's total area, about 152,000 square miles are land, and almost 8,000 square miles are water.

The Pacific Ocean forms the western boundary of California, with a coastline more than 1,200 miles long. These coastal areas range from southern California's sunny beaches to northern California's fog-shrouded redwood forests. The inland valleys, with their hot summers and cool winters, have millions of acres of cropland. The Sierra Nevada in the eastern half of California runs nearly two-thirds the length of the State. Most of the southeastern portion of the State is desert, varying from sun-baked Death Valley to the scenic mountain ranges of the Mojave Desert. To a large degree, California's pleasant climate and abundance of relatively level land are the major features that have drawn people to the State.

Quick Facts

Over the last 20 years, California's population has nearly doubled and its economy has prospered. However, despite substantial growth, California has made dramatic progress in improving air quality.

- The population increased 40 percent and vehicle miles traveled during this same period more than doubled.
- Emissions of ROG and NO_x have been reduced by 60 percent and 26 percent, respectively.
- The number of unhealthy days with concentrations exceeding the State ozone standards decreased an average of 43 percent. While PM_{10} standard exceedance days decreased by 21 percent over the last 18 years.
- Population exposure to values above the State 8-hour ozone standard dropped an average of over 70 percent in the major urban areas.
- The entire state now meets all State and national standards with the exception of ozone and PM.

Despite the magnitude of progress, ozone and PM remain major air quality challenges.

- Today, nearly all Californians (about 99 percent) live in areas that are designated as nonattainment for the State health-based ozone and/or PM standards. Additionally, about 93 percent live in areas that are designated as nonattainment for the national health-based ozone and/or PM standards.
- Ozone and PM concentrations in the areas with the most severe problems can be as high as two to three times the level of the State standards on the worst days.
- In the areas with the worst air quality problems, the State ozone and PM standards can be exceeded up to 200 days per year.

Information on the following pages provides a more in-depth description of the current ozone and PM problems in California.

Quick Facts

Ozone

This map provides a quick look at the ozone air quality in California. It shows the number of unhealthy days with concentrations greater than the State ozone standard (exceedance days) that occurred in each air basin during 2006. It is important to keep in mind that the number of exceedance days reflects all sites in the basin and that the number can be influenced by a few high sites. This map does not show how air quality differs spatially within an area (see Chapter 4).

The ozone air quality problem varies across the State. There are some rural and coastal areas with none to a few exceedance days. Higher values are found in the more urbanized inland areas and desert regions, with over 50 percent of the State's population living in areas with 100 or more days exceeding the State 8-hour standard.

Figure 1-1

- California's coastal regions have a temperate climate, with relatively cool temperatures and a pattern of onshore/offshore airflow. Both of these factors favor relatively good air quality. As shown in Figure 1-1, most coastal areas, including the Bay Area, Monterey, Santa Barbara, and San Diego have a small number of exceedance days compared to the inland regions.
- Inland valleys have many more days with sunshine and high temperatures that provide favorable conditions for ozone formation. In addition, frequent temperature inversions coupled with surrounding mountains limit the dispersion of pollutants. The inland regions of the South Coast, San Joaquin Valley, and portions of the Sacramento region have the most severe ozone air quality problems in the State.
- Further inland, the desert regions pose their own challenges to air quality progress. These regions can be the recipients of ozone transported from upwind areas. Therefore, their progress is linked to the progress made upwind. In addition, the desert regions have more days throughout the year with sunshine and high temperatures, which can contribute to locally generated ozone. The desert regions include the Mojave Desert and eastern Kern, eastern Riverside, and Imperial counties.
- Ozone air quality still poses a substantial challenge in California, but both the maximum concentrations and the number of exceedance days continue to decline. Areas have made tremendous progress over the past several decades. However, despite

this progress, the maximum measured 1-hour and 8-hour ozone concentrations in the worst areas were both about twice the level of the respective State standard during 2006. Without a doubt, there is much more to accomplish.

Particulate Matter

The following map shows the estimated number of days in which the State 24-hour PM_{10} standard was exceeded in each air basin of California. Unlike the ozone map on the previous page which shows an exact count of basinwide exceedance days, the PM_{10} map shows an estimated number of exceedance days. Because PM_{10} samples are sampled only once every 6 days, we estimate the total by extrapolating from the percentage of total monitored days that exceeded the standard. In addition, on the PM_{10} map the data for each air basin reflect only the number of estimated exceedances at the one site with the highest total, whereas the ozone map reflects a composite of exceedance days at all sites in the air basin. During 2006, in the Lake Tahoe air basin, data for the high site was incomplete.

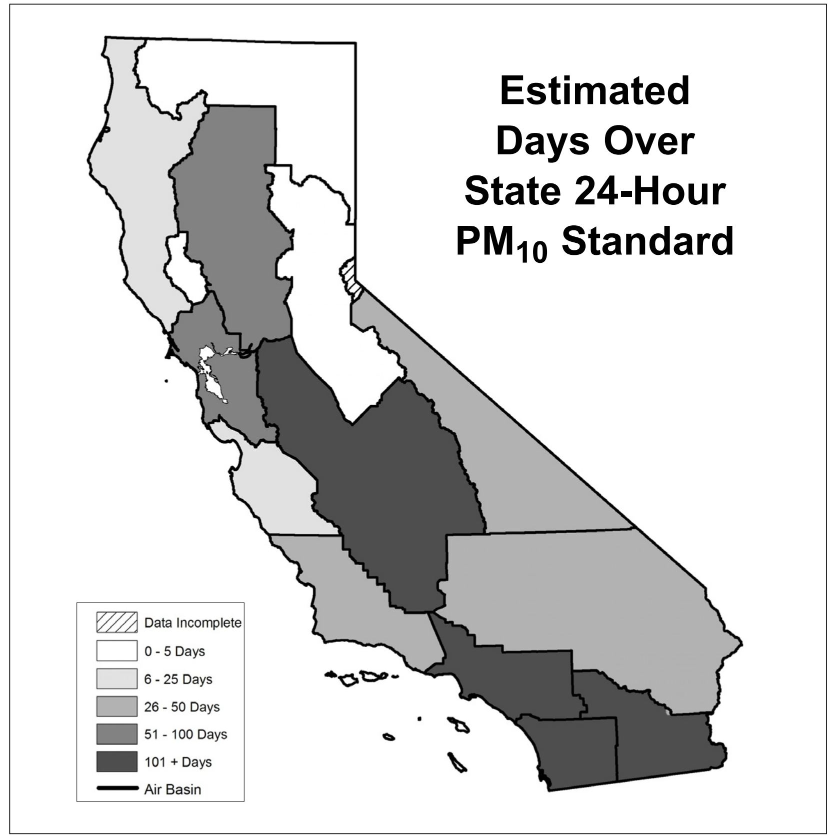

Figure 1-2

- Generally, the greatest number of estimated exceedance days occurred at sites in the urbanized areas during 2006.
- There were also a relatively high number of days in the Great Basin Valleys Air Basin, where high winds aggravate the local PM_{10} problem.
- In the areas where the estimated number of exceedance days are highest, the South Coast, San Joaquin Valley, San Diego, and Salton Sea air basins, the number tends to be very high. All four of these areas had well over 100 estimated exceedance days during 2006: 241 in South Coast, 167 in San Joaquin Valley, 159 in San Diego, and 241 in Salton Sea.
- Although not shown here, annual PM_{10} concentrations in the worst urban areas were over twice the level of the State PM_{10} standard (in 2006, a maximum of 56 micrograms per cubic meter ($\mu g/m^3$) in the San Joaquin Valley Air Basin and 62 $\mu g/m^3$ in the South Coast Air Basin, compared with a standard of 20 $\mu g/m^3$). In contrast, peak 24-hour concentrations in the worst urban areas were up to four times the level of the State standard (in 2006, a maximum of 169 $\mu g/m^3$ in San Diego, 206 $\mu g/m^3$ in San Joaquin Valley, and 124 $\mu g/m^3$ in South Coast, compared with a standard of 50 $\mu g/m^3$).
- Similar to ozone, PM_{10} still poses substantial challenges. However, over the last 15 years, almost all areas show progress, although at a slower rate relative to ozone. Additional emission controls will be needed to attain the PM_{10} standards in all areas of the State.

Interpreting the Emission and Air Quality Statistics

Interpreting Criteria Pollutant Emission and Air Quality Statistics. A number of pollutant trends are presented in this almanac. Emission and air quality trends for the same pollutant are usually correlated. In some cases, however, the two trends may differ, at least in terms of the rate of increase or decrease. The comparison of emission trends to air quality trends is complex, and a number of confounding factors can affect the resulting trends, such as the impacts of ozone and transported PM from one area to another. An area can show a stable (or flat) emission trend because local emission growth offsets the reductions achieved through technology, but this same area may show an improvement in air quality because ambient concentrations reflect the impact of transport from an upwind region that has improved. Other factors that can affect air quality are meteorology, which can cause large differences from year-to-year, and changes in monitoring sites (both site closures and the establishment of new sites). In addition, the emission data and some air quality statistics are based on estimates. These estimates use the best available methods, however, they embody some degree of uncertainty. All of these factors should be kept in mind when using and interpreting the trends.

Emission inventory trends make use of historical emission inventory data and projections based on expectations of future economic and population growth and emission controls. The historical emission inventory data in this almanac were updated to reflect improvements in emission inventory methodologies. The future year projections for stationary and areawide sources were developed using the California Emission Forecasting System (CEFS) model assuming a 2006 base year and California-specific economic projections. The emissions data in this edition are the same as presented in the previous edition and will be updated in the 2009 Almanac. These economic projections were prepared by E.H. Pechan and Associates and reflect information provided by local air districts. The stationary source emission forecasts reflect control measure information received from local air districts as of September 2006. Future year emission projections for on- and off-road vehicles were developed using the ARB EMFAC2007 and OFFROAD2007 models, respectively. State Implementation Plan (SIP) and conformity inventory forecasts may differ from the forecasts presented in this almanac. For more information on these forecasts, please see the ARB SIP web page at *www.arb.ca.gov/sip/siprev1.htm*.

In general, the criteria pollutant air quality trends in this almanac represent data that have been summarized from a network of monitoring sites to characterize the air quality in a particular region (for example, a county or air basin). Whenever data are summarized, the resulting statistics may be influenced by a number of factors, including the number of monitoring sites in operation and the completeness of the data. To help in interpreting the air quality trends, the ARB has included information on the time periods for which air quality data are available for different pollutants at sites in California and Baja, Mexico in its publication titled: *"California State and Local Air Monitoring Network Plan - 2007"*. This report is available on the web at *www.arb.ca.gov/aqd/netrpt/netrpt.htm*, or from the ARB's Planning and Technical Support Division by calling (916) 322-5350.

A number of air quality statistics or indicators are used in this document. In general, 1-hour, 8-hour, and 24-hour concentrations reflect measured values and can be summarized by day, season, or year. These data are also used to determine the number of days in which State or national standards were exceeded. For the most part, this almanac provides data summarized as annual values. In contrast to measured values, the peak indicators are calculated values based on measured data. The peak indicator is used throughout the almanac for air quality trends for State standards. It represents the maximum concentration expected to be exceeded no more than once per year, on average, based on the distribution of the data for each monitoring site. Because it is based on a robust statistical calculation using three years of data, it is relatively stable, thereby providing a trend indicator that is not highly influenced by year-to-year changes in weather. Finally, it is important to point out that the calculated number of days above the State and national PM_{10} and $PM_{2.5}$ standards differ from other pollutants in that they are statistically derived from the measured data. This is because PM monitoring does not occur every day.

Interpreting the Toxic Air Contaminant Emission and Air Quality Statistics. This almanac includes emission data, ambient concentrations, and health risk estimates for the ten toxic air contaminants (TACs) that generally pose the greatest known ambient risk in California. A TAC is defined as "an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health" (Health and Safety Code section 39655). Numerous factors influence ambient measurements of TACs, and a number of assumptions are embodied in the summary statistics. Only the most important factors are summarized below.

The toxics emission inventory for 2006 represents the most current inventory compiled by the ARB staff and is the same inventory as the 2007 edition of the Almanac. The toxic emissions for stationary sources include emission data from the AB 2588 Air Toxics "Hot Spots" Program. For all source categories associated with diesel fuel combustion, all PM emitted from these sources was considered "diesel PM." The areawide source emissions were estimated by either the local air districts or the ARB staff. These toxic emission estimates were developed by speciating criteria emissions. Emission estimates for the other mobile source categories are primarily from ARB's OFFROAD2007 model, speciated for toxics. For the categories not currently included in the model, the emission estimates have been developed by either local air districts or ARB staff. Local air districts may also provide estimates for categories usually developed by ARB staff. In this case, toxic emissions for all area sources and mobile sources are estimated by speciating criteria pollutants with category specific profiles. Finally, the on-road mobile source emission estimates are based on the current model, EMFAC2007. Again, the emission estimates have been speciated for toxics. The toxics emissions data are the same as presented in the previous edition and will be updated in the 2009 Almanac.

Air quality statistics are based on the analysis of monitoring data collected by the ARB. TAC air quality data are also collected by the local air districts and for special studies. However, for consistency, only data collected by the ARB are included here. Based on available data, the ten TACs that pose the greatest known ambient risk are acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel particulate matter (diesel PM).

The ARB established the TAC network after the California Legislature enacted a program in 1983 to identify the health effects of TACs and reduce their exposure to protect the public health. The network measures the presence of TACs in the ambient air, and statewide toxics monitoring data are available from 1989 onwards. In general, TAC concentrations are sampled once every twelve days, for an average of two to three samples per month. The measured concentrations are used to represent average statewide concentrations and health risk. It is important to note that actual concentrations can vary from one location to another, and local concentrations and risks may be either higher or lower than the average values. The ARB has also been involved in efforts to better characterize local and community-wide exposures, and more information on these studies is available at *www.arb.ca.gov/ch/ch.htm*.

Since the TAC network began operation, there have been some site changes. In several cases, the site changes occurred during the middle of a year. Because the site-by-site statistics presented in Appendix C do not combine concentrations measured at different sites, an annual average for the year during which the site change occurred will be missing for those sites. Since all of the valid monthly means from each site are included in the air basin or statewide annual average, the site changes may lead to some variation in year-to-year statistics. In particular, the average health risk estimates may include a varying number of compounds and sites. Therefore, they may not be directly comparable from one year to the next. Site changes in each of the five major air basins are described in Chapter 5.

During the normal course of monitoring, most of the TACs have experienced some missing data due to sampling or analysis problems, and several TACs show substantial gaps in their data record. The every 12 days sampling schedule only allows for two or three samples to be collected at each site during any month. In order to calculate a valid annual average (a mean of monthly means), each month during the year must have at least one valid measurement. Therefore, if there are no valid data in any given month, data for the year will appear to be missing, even though some data may be available.

In some cases, TAC concentrations are below the level that an instrument can reliably measure. For these measurements, the values are assumed to be one-half the detection limit when estimating an annual average. Table 5-1 in Chapter 5 lists the detection limits for the ten TACs discussed in this almanac. It is important to note that the concentrations and health risk estimates presented in this almanac are based on ambient outdoor measurements. They do not account for any indoor exposures to TACs, which can contribute significantly to individual health risk.

The health risk estimates reflect the estimated number of excess cancer cases per million people exposed over a 70-year period. These data are very useful for comparing relative health risks for the ten compounds considered (e.g., comparing the level of health risk for one compound or area relative to another). However, it is important to note that there are varying degrees of uncertainty associated with these data. The risks presented are only for the ten compounds considered. In addition, the risk is for the general population's outdoor exposure, and actual health risk may be higher or lower than reported here. Furthermore, a number of factors add to the uncertainty, including the assumptions of the underlying risk factors, the assumption of a constant 70-year exposure, measurement biases and uncertainties, and the absence of ambient air quality data for other TACs that may pose a substantial health risk. Since risk data do not have precision at the tenth decimal place, risks that are less than one excess cancer case per million people are expressed as "<1".

Meteorology's Role in Air Quality

This almanac presents air quality trends for a 20-year period. These trends reflect the progress achieved through a long history of emission control programs. Besides emissions, the trends are affected by meteorology (weather) and terrain. Meteorology causes year-to-year changes in air quality trends that can mask the benefits of emission reductions. Therefore, this almanac focuses on long-term rather than short-term trends.

Meteorology does not affect all pollutants in all places the same way. Ozone is formed in the atmosphere as sunlight initiates a complex set of chemical reactions. On hot sunny days, the abundant sunlight starts the ozone-forming processes and high temperatures promote fast chemical reactions. If the air is stagnant, the ozone formed is not dispersed or diluted by cleaner air. So, the highest ozone concentrations usually occur on hot and sunny days with light breezes or calm air. In some areas, high ozone levels may represent transport from upwind regions; local weather conditions associated with transport may differ from place to place. Since hot and sunny summer days typically lead to high ozone, it is not surprising that cold and cloudy winter days have much lower concentrations.

California's terrain also plays a role in promoting high levels of pollutants. The mountains that surround the San Joaquin Valley and those that form a barrier to the east of the Los Angeles area tend to retain air within these basins, which limits the dispersion of all pollutants, including ozone.

Meteorology affects PM, though some of its effects on PM differ from its effects on ozone. Ambient PM is comprised of primary PM that is directly emitted and secondary PM that forms in the atmosphere through chemical and physical processes. Primary PM includes dust and soot, while secondary PM includes particulate nitrates and sulfates. Some areas are subject to strong winds that lift dust into the air resulting in high concentrations of primary PM. On November 29, 1991, dry hurricane-force winds in the San Joaquin Valley created a massive dust storm and extremely high PM levels. In other situations, cold, calm, and humid air can promote the buildup of secondary PM. Relatively high PM levels in the South Coast and San Joaquin Valley often occur in the winter under these meteorological conditions. Because winds disperse PM and rain washes PM out of the air, the lowest PM concentrations often occur on rainy winter days.

Meteorology impacts air quality, and year-to-year variations in meteorology can affect year-to-year changes in ambient air quality trends. As a result, meteorological variations add to the difficulty of interpreting long-term air quality trends. However, data for meteorological parameters such as temperature, wind speed, and wind direction can help characterize a year with respect to the weather conditions influencing air pollution. For example, an analysis of daily weather conditions in the South Coast Air Basin showed that there were many days during 1981, 1994, 1995, and 2003 with weather conditions favoring high levels of ozone. In contrast, there were fewer such days during 1986, 1987, 1991, and 1993. A similar analysis of daily weather conditions in the San Joaquin Valley showed a higher than average number of days with high ozone forming potential during 1994, 1996, 2001, 2002, and 2003, while 1997, 1998, and 1999 had a lower than average numbers of such days. Similar to ozone, annual average PM concentrations are also affected by meteorology – in particular, rainfall. In northern California, 1998 had many rainy days which resulted in lower annual average PM concentrations. In contrast, the following year was quite dry, and annual average PM concentrations increased. These year-to-year variations in the average meteorological conditions are reflected in the long-term pollutant trends.

A full accounting of the impact of weather on pollution levels is desirable but challenging. ARB is currently developing methods to account for these impacts when evaluating air qualiy trends.

The Web Resources Section provides information on how to access sources of meteorological data. Sources such as ARB's real-time Air Quality and Meteorological Information System (AQMIS2) allow access to various wind parameters including wind speed/direction, temperature, humidity, and visibility.

Sources of Emissions in California

California is a diverse state with many sources of air pollution. To estimate the sources and quantities of pollution, the ARB, in cooperation with local air districts and industry, maintains an inventory of California emission sources. Sources are subdivided into four major emission categories: stationary sources, area-wide sources, mobile sources, and natural sources.

Stationary source emissions are based on estimates made by facility operators and local air districts. Emissions from specific facilities can be identified by name and location. Area-wide emissions are estimated by ARB and local air district staffs. Emissions from area-wide sources may be either from small individual sources, such as residential fireplaces, or from widely distributed sources that cannot be tied to a single location, such as consumer products and dust from unpaved roads. Mobile source emissions are estimated by ARB staff with assistance from districts and other government agencies. Mobile sources include on-road cars, trucks, and buses and other sources such as boats, off-road recreational vehicles, aircraft, and trains. Natural sources are also estimated by the ARB staff and the air districts. These sources include biogenic hydrocarbons, geogenic hydrocarbons, natural wind-blown dust, and wildfires.

For the inventoried emission sources, the ARB compiles emission estimates for both the criteria pollutants and TACs. Chapters 2 through 4 and Appendices A and B focus on five criteria pollutants: ozone, PM, CO, NO_2, and SO_2. Emissions related to these criteria pollutants include reactive organic gases (ROG), oxides of nitrogen (NO_x), CO, oxides of sulfur (SO_x), ammonia (NH_3), and directly emitted PM_{10} and $PM_{2.5}$.

While some pollutants, such as CO, are directly emitted, others are formed in the atmosphere from *precursor emissions*. Such is the case with ozone, which is formed in the atmosphere when ROG and NO_x precursor emissions react in the presence of sunlight. PM which includes PM_{10} and $PM_{2.5}$, is a complex pollutant that can either be directly emitted or formed in the atmosphere from precursor emissions. PM precursors include NO_x, ROG, SO_x, and NH_3. Examples of directly emitted PM include dust and soot.

Hydrocarbon is a general term used to describe compounds comprised of hydrogen and carbon atoms. Hydrocarbons are classified as to how photochemically reactive they are: relatively reactive or relatively non-reactive. Emissions of *Total Organic Gases* (TOG) and *Reactive Organic Gases* (ROG) are two classes of hydrocarbons measured for California's emissions inventory. TOG includes all hydrocarbons, both reactive and non-reactive. In contrast, ROG includes only the reactive hydrocarbons.

In addition to information about the criteria pollutants, Chapter 5 and Appendix C focus on the ten TACs that pose the greatest potential health risk, primarily based on statewide ambient air quality data. These ten TACs are: acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel PM. Excluding diesel PM, the remaining nine TACs represent about 94 percent of the potential health risk as measured through the statewide TAC air monitoring network. Although diesel PM is not currently monitored, emissions and modeled ambient concentrations indicate that diesel PM has a higher health risk than the other nine compounds combined. It is important to note that there may be other compounds that pose a substantial risk, but have not yet been identified as a concern and which data are not yet available or are currently under review.

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Air Quality Monitoring

Meteorology acts on the emissions released into the atmosphere to produce pollutant concentrations. These airborne pollutant concentrations are measured throughout California at air quality monitoring sites. The ARB operates a statewide network of monitors. Data from this network are supplemented with data collected by local air districts, other public agencies, and private contractors.

As shown in Figure 1-3, there are more than 250 criteria pollutant monitoring sites in California. Currently, the ARB also monitors ambient concentrations of TACs at 17 of these sites. In addition to the California sites, a few monitoring sites are located in Mexico. These sites were established in cooperation with the U.S. EPA and the Mexican government to monitor the cross-border transport of pollutants and pollutant precursors.

Each year, more than ten million air quality measurements from all of these sites are collected and stored in a comprehensive air quality database maintained by the ARB. To ensure the integrity of the data, the ARB routinely conducts audits and reviews of the monitoring instruments and the resulting data.

Figure 1-3

California Air Basins

California contains a wide variety of climates, physical features, and emission sources. This variety makes the task of improving air quality complex, because what works in one area may not be effective in another area. To better manage common air quality problems, California is divided into 15 air basins, as shown in Figure 1-4 and Table 1-1. The ARB established the initial air basin boundaries during 1968.

An air basin generally has similar meteorological and geographical conditions throughout. To the extent possible, the air basin boundaries follow along political boundary lines and are defined to include both the source area and the receptor area. However, air masses can move freely from basin to basin. As a result, pollutants such as ozone and PM, as well as their precursors, can be transported across air basin boundaries, and interbasin transport is a reality that must be dealt with in air quality programs. Although established in 1968, the air basin boundaries have been changed several times over the years, to provide for better air quality management.

Figure 1-4

List of Counties in Each Air Basin

Great Basin Valleys Air Basin
- Alpine
- Inyo
- Mono

Lake County Air Basin
- Lake

Lake Tahoe Air Basin
- El Dorado (portion)
- Placer (portion)

Mojave Desert Air Basin
- Kern (portion)
- Los Angeles (portion)
- Riverside (portion)
- San Bernardino (portion)

Mountain Counties Air Basin
- Amador
- Calaveras
- El Dorado (portion)
- Mariposa
- Nevada
- Placer (portion)
- Plumas
- Sierra
- Tuolumne

Table 1-1

North Central Coast Air Basin
- Monterey
- San Benito
- Santa Cruz

North Coast Air Basin
- Del Norte
- Humboldt
- Mendocino
- Sonoma (portion)
- Trinity

Northeast Plateau Air Basin
- Lassen
- Modoc
- Siskiyou

Sacramento Valley Air Basin
- Butte
- Colusa
- Glenn
- Placer (portion)
- Sacramento
- Shasta
- Solano (portion)
- Sutter
- Tehama
- Yolo
- Yuba

List of Counties in Each Air Basin

Salton Sea Air Basin
- Imperial
- Riverside (portion)

San Diego Air Basin
- San Diego

San Francisco Bay Area Air Basin
- Alameda
- Contra Costa
- Marin
- Napa
- San Francisco
- San Mateo
- Santa Clara
- Solano (portion)
- Sonoma (portion)

San Joaquin Valley Air Basin
- Fresno
- Kern (portion)
- Kings
- Madera
- Merced
- San Joaquin
- Stanislaus
- Tulare

Table 1-1 (continued)

South Central Coast Air Basin
- San Luis Obispo
- Santa Barbara
- Ventura

South Coast Air Basin
- Los Angeles (portion)
- Orange
- Riverside (portion)
- San Bernardino (portion)

Criteria Air Pollutants

California and National Ambient Air Quality Standards

Very simply, an ambient air quality standard is the definition of "clean air." More specifically, a standard establishes the concentration above which the pollutant is known to cause adverse health effects to sensitive groups within the population, such as children and the elderly. Both the California and federal governments have adopted health-based standards for the *criteria pollutants*, which include but are not limited to ozone, PM_{10}, $PM_{2.5}$, and CO. U.S. EPA recently revised the national PM and ozone standards. Information on the new PM standards can be found on the U.S. EPA's website at *www.epa.gov/air/particlepollution/actions.html* and on the new ozone standards at *www.epa.gov/air/ozonepollution/actions.html*.

For most pollutants the State standards are more stringent than the national standards. The differences in the standards are generally explained by the different health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the State standards incorporate a margin of safety to protect sensitive individuals (an abbreviated list of the State and national ambient air quality standards can be found on page 1-22, while a complete list can be found on the ARB website at *www.arb.ca.gov/research/aaqs/aaqs.htm*). In general, the air quality standards are expressed as a measure of the amount of pollutant per unit of air. For example, the PM standards are expressed as micrograms of particulate matter per cubic meter of air ($\mu g/m^3$) and the ozone standards are expressed in parts per million (ppm).

Ozone

Ozone, a colorless gas which is odorless at ambient levels, is the chief component of urban smog. Ozone is not directly emitted as a pollutant, but is formed in the atmosphere when hydrocarbon and NO_x precursor emissions react in the presence of sunlight. Meteorology plays a major role in ozone formation. Generally, low wind speeds or stagnant air, coupled with warm temperatures and cloudless skies provide the optimum conditions for ozone formation. As a result, summer is generally the peak ozone season. Because of the reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. Therefore, ozone is a regional pollutant that often impacts a large area.

The ARB and EPA are required to periodically review its air quality standards and the most recent health studies to ensure that the standards are adequately protective of human health. Air quality standards have become more stringent over time as new studies have shown adverse impacts at lower concentration levels.

Most recently, ARB and EPA have adopted 8-hour ozone standards designed to protect the public against the chronic health effects from day-long exposures to unhealthy ozone concentrations. California also has a 1-hour standard to protect the public against acute exposures from elevated short-term ozone concentrations.

California's 8-hour ozone standard of 0.070 ppm is the most health-protective ozone standard in the country. On March 12, 2008, U.S. EPA completed their review of the most current health studies and concluded that the level of the current national ozone standard at 0.08 ppm was not sufficiently protective of human health. They adopted a new standard of 0.075 ppm, which will become effective later this year. It will trigger a new set of planning requirements in the next three years which will build upon our current SIP efforts. For more information on the new national ozone standard, please refer to the U.S. EPA's webpage at *http://www.epa.gov/air/ozonepollution/actions.html*.

State Ozone Standards:
0.070 ppm for 8 hours,
not to be exceeded *and*
0.09 ppm for 1 hour,
not to be exceeded.

National Ozone Standard:
0.08 ppm for 8 hours,
not to be exceeded,
based on the fourth highest
concentration averaged
over three years.

Table 1-2

Particulate Matter (PM_{10} and $PM_{2.5}$)

Exposure to PM aggravates a number of respiratory illnesses and may even cause early death in people with existing heart and lung disease. Both long-term and short-term exposure can have adverse health impacts. All particles with a diameter of 10 microns or smaller (PM_{10}) are harmful. For comparison, the diameter of a human hair is about 50 to 100 microns. PM_{10} includes the subgroup of finer particles with an aerodynamic diameter of 2.5 microns or smaller ($PM_{2.5}$). These finer particles pose an increased health risk because they can deposit deep in the lung and contain substances that are particularly harmful to human health.

PM is a mixture of substances that includes elements such as carbon and metals; compounds such as nitrates, sulfates, and organic compounds; and complex mixtures such as diesel exhaust and soil. These substances may occur as solid particles or liquid droplets. Some particles are emitted directly into the atmosphere. Others, referred to as secondary particles, result from gases that are transformed into particles through physical and chemical processes in the atmosphere.

In 1982, the ARB adopted 24-hour average and annual average PM_{10} standards. National ambient air quality standards for PM_{10} have been in place since 1987. However, California's PM_{10} standards are more health-protective.

In June 2002, the ARB lowered the level of the PM_{10} annual standard from 30 $\mu g/m^3$ to 20 $\mu g/m^3$ and established a new annual $PM_{2.5}$ standard of 12 $\mu g/m^3$. The ARB plans to review short-term PM exposure studies in the future to determine if the current State 24-hour PM standards adequately protect public health. Additional information on the State PM standards is available on the ARB's website at *www.arb.ca.gov/research/aaqs/std-rs/std-rs.htm.*

The U.S. EPA promulgated new national ambient air quality standards for $PM_{2.5}$ in 1997 (annual of 15 $\mu g/m^3$ and 24-hour of 65 $\mu g/m^3$) to complement the national PM_{10} standards. SIPs for these standards were due in Spring 2008. In 2006, U.S. EPA strengthened the 24-hour $PM_{2.5}$ standard (to 35 $\mu g/m^3$) and revoked the annual PM_{10} standard. SIPs for the revised $PM_{2.5}$ standard are due in 2012.

State PM_{10} Standards:
50 $\mu g/m^3$ for 24 hours
not to be exceeded *and*
20 $\mu g/m^3$ annual arithmetic mean,
not to be exceeded.
State $PM_{2.5}$ Standard:
12 $\mu g/m^3$ annual arithmetic mean,
not to be exceeded.

National PM_{10} Standard:
150 $\mu g/m^3$ for 24 hours, not to be exceeded,
more than once per year.
National $PM_{2.5}$ Standards:
35 $\mu g/m^3$ for 24 hours based on the
98th percentile concentration averaged
over three years, not to be exceeded *and*
15 $\mu g/m^3$ annual arithmetic mean
averaged over 3 years, not to be exceeded.

Table 1-3

Carbon Monoxide

Carbon monoxide is a colorless and odorless gas that is directly emitted as a by-product of combustion. The highest concentrations are generally associated with cold stagnant weather conditions that occur during winter. In contrast to ozone, which tends to be a regional pollutant, CO problems tend to be localized.

Carbon monoxide is harmful because it is readily absorbed through the lungs into the blood, where it binds with hemoglobin and reduces the ability of the blood to carry oxygen. As a result, insufficient oxygen reaches the heart, brain, and other tissues. The harm caused by CO can be critical for people with heart disease (angina), chronic lung disease, or anemia, as well as for unborn children. Even healthy people exposed to high levels of CO can experience headaches, fatigue, slow reflexes, and dizziness. Health damage caused by CO is of greater concern at high elevations where the air is less dense, aggravating the consequences of reduced oxygen supply. As a result, California has a more stringent CO standard for the Lake Tahoe Air Basin.

State CO Standards:

20 ppm for 1 hour *and*
9.0 ppm for 8 hours,
neither to be exceeded.

6 ppm for 8 hours
(Lake Tahoe Air Basin only),
not to be equaled or exceeded.

National CO Standards:

35 ppm for 1 hour *and*
9 ppm for 8 hours,
neither to be exceeded more than once per year.

Table 1-4

Air Quality Standards

Pollutant	Averaging Time	California Standards[1]	National Standards[2]	
		Concentration	Primary[3]	Secondary[4]
Ozone (O_3)	1 Hour	0.09 ppm	—	—
	8 Hour	0.070 ppm	0.08 ppm	Same as Primary Standard
Particulate Matter (PM_{10})	24 Hour	50 $\mu g/m^3$	150 $\mu g/m^3$	Same as Primary Standard
	Annual Arithmetic Mean	20 $\mu g/m^3$	—	
Fine Particulate Matter ($PM_{2.5}$)	24 Hour	—	35 $\mu g/m^3$	Same as Primary Standard
	Annual Arithmetic Mean	12 $\mu g/m^3$	15 $\mu g/m^3$	
Carbon Monoxide (CO)	8 Hour	9.0 ppm	9 ppm	None
	1 Hour	20 ppm	35 ppm	
	8 Hour (Lake Tahoe)	6 ppm	—	—
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm	0.053 ppm	Same as Primary Standard
	1 Hour	0.18 ppm	—	
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	—	0.030 ppm	—
	24 Hour	0.04 ppm	0.14 ppm	—
	3 Hour	—	—	0.5 ppm
	1 Hour	0.25 ppm	—	—
Lead	30 Day Average	1.5 $\mu g/m^3$	—	—
	Calendar Quarter	—	1.5 $\mu g/m^3$	Same as Primary Standard

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, PM_{10}, $PM_{2.5}$, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.
2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM_{10}, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For $PM_{2.5}$, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.
3. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.
4. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Table 1-5

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California and National Area Designations

Both the California and federal governments use monitoring data to designate areas according to their attainment status for most of the pollutants with ambient air quality standards. The purpose of the designations is to identify those areas with air quality problems and thereby initiate planning efforts to make the air more healthful. There are three basic designation categories: nonattainment, attainment, and unclassified. In addition, the State designations include a subcategory of the nonattainment designation, called nonattainment-transitional. The nonattainment-transitional designation is given to nonattainment areas that are making progress and nearing attainment.

A *nonattainment designation* indicates that the air quality violates an ambient air quality standard. Although a number of areas may be designated as nonattainment for a particular pollutant, the severity of the problem can vary greatly. For example, in two ozone nonattainment areas, the first area has a measured maximum concentration of 0.13 ppm, while the second area has a measured maximum concentration of 0.23 ppm. While both areas are designated as nonattainment, it is obvious that the second area has a more severe ozone problem and will need a more stringent emission control strategy. To identify the severity of the problem and the extent of planning required, ozone and PM nonattainment areas are assigned a classification that is commensurate with the severity of their air quality problem (e.g., moderate, serious, severe).

In contrast to nonattainment, an *attainment designation* indicates that the air quality does not violate the established standard. Under the federal Clean Air Act, nonattainment areas that are redesignated as attainment must develop and implement maintenance plans designed to assure continued compliance with the standard.

Finally, an *unclassified designation* indicates that there are insufficient data for determining attainment or nonattainment. The U.S. EPA combines unclassified and attainment into one designation for ozone, PM_{10}, $PM_{2.5}$ and CO. More detailed information on the area designation categories can be found on the ARB's website at *www.arb.ca.gov/desig/desig.htm*.

Ozone - State Area Designations

On April 28, 2005, the ARB approved the nation's most health-protective ozone standard, with special consideration for children's health. The new 8-hour average standard of 0.070 ppm will further protect California's most vulnerable population from the chronic adverse health effects associated with ground-level ozone, or smog. ARB retained the 1-hour standard of 0.09 ppm to continue to protect the public from health effects associated with acute short-term exposures.

Figure 1-5 shows the State ozone designations which became effective July 26, 2007. The designation map on this page reflects the designations as approved by the Board. These designations reflect both the 1-hour and 8-hour standards. In order to be designated as attainment, an area must meet both standards. Because the 8-hour standard is more health-protective, there are now more nonattainment areas than during previous years, when only the 1-hour standard was in effect.

As indicated on the map, only a few areas attain the State ozone standards. However, new air quality plans and emission controls strategies will continue to reduce emissions and move areas closer to attainment.

Figure 1-5

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Ozone - National 8-Hour Area Designations

Figure 1-6 shows the designations for the national 8-hour standard, which became effective on June 15, 2004. An area violates the national 8-hour ozone standard if the calculated fourth highest 8-hour concentrations averaged over a three-year period exceeds the level of the standard at any monitoring site in the region. There are 15 nonattainment areas in California, including the State's five largest urban areas. In addition, a number of smaller counties and rural areas exceed the standard. California has submitted to the U.S. EPA 8-hour ozone SIPs needed to attain this standard.

Figure 1-6

PM_{10} - State Area Designations

The majority of California is designated as nonattainment for the State PM_{10} standards. Three areas in the northern half of the State, Siskiyou County, Lake County, and Northern Sonoma Air District, have been designated as attainment.

PM_{10} remains a widespread problem, and its causes are very diverse. Because of the variety of sources and the size and chemical make-up of the particles, the PM_{10} problem can vary considerably from one area to the next. In addition, high PM_{10} concentrations are seasonal, and the high season varies from area to area. For example, in some areas, windblown dust may contribute to high PM_{10} concentrations in the summer and fall, while in other areas, high concentrations due to secondary particles may occur during the winter. As a result, two areas with similar PM_{10} concentrations may have very different PM_{10} problems, and multiple control strategies are needed to effectively deal with these problems.

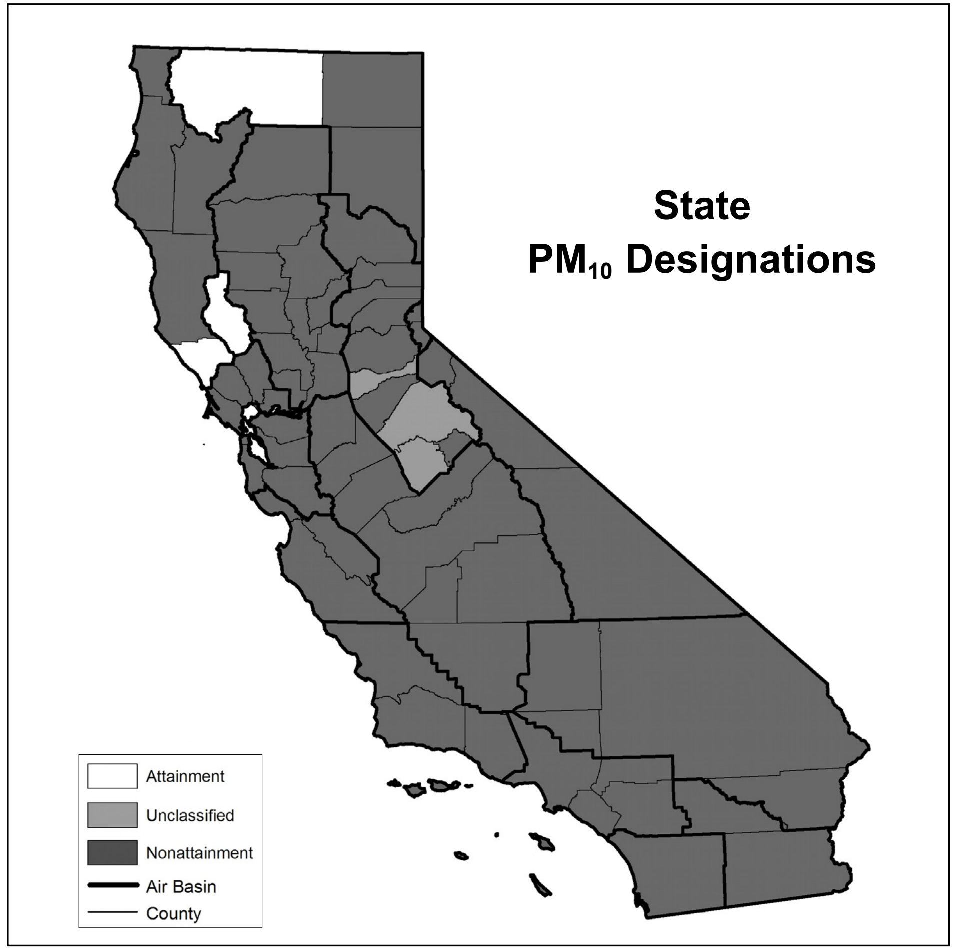

Figure 1-7

PM_{10} - National Area Designations

In contrast to the State PM_{10} designations, there are only two designation categories for the national PM_{10} standard: attainment/ unclassified and nonattainment. Areas designated as nonattainment for the national PM_{10} standard are required to develop and implement plans designed to meet the standard. Although not reflected in Figure 1-8, the San Joaquin Valley Air Basin is now in attainment of the national standard. Areas still designated as nonattainment, but which meet the national PM_{10} standard, include the South Coast Air Basin, Sacramento County, Mammoth Lakes, Trona (northwestern San Bernardino County), and that portion of San Bernardino County outside of the South Coast Air Basin.

Figure 1-8

$PM_{2.5}$ - State Area Designations

California adopted the new $PM_{2.5}$ standard in 2002, and this is the fourth year of area designations for the State $PM_{2.5}$ standard. Approximately half of California is designated as nonattainment for the State $PM_{2.5}$ standard, with the Lake County, Lake Tahoe, and North Central Coast air basins and San Luis Obispo County designated as attainment. Nonattainment areas include all of the major urban areas, as well as a few rural areas. Secondary formation of $PM_{2.5}$ and particles directly emitted from combustion processes are major contributors to high $PM_{2.5}$ concentrations in these areas.

California's programs to reduce ozone, PM_{10}, and diesel PM are also helping reduce $PM_{2.5}$. In addition, as required by legislation enacted in 2003 (Senate Bill 656), ARB assembled a list of measures that can be used by air districts to further reduce PM and PM precursors. Air districts recently adopted implementation schedules for a subset of these measures to address the nature and severity of their PM problem. This list is available on the web at *www.arb.ca.gov/pm/pmmeasures/pmmeasures.htm*.

Figure 1-9

$PM_{2.5}$ - National Area Designations

The U.S. EPA promulgated first time area designations for $PM_{2.5}$ in early 2005. The San Joaquin Valley and South Coast air basins are the only two areas designated as nonattainment. These air basins include major urban areas, as well as some rural areas. Reactions in the atmosphere from precursor gases emitted from combustion sources and direct particulate emissions from mobile sources and burning activities lead to high $PM_{2.5}$ concentrations in these areas. The remaining areas of the State are designated as unclassified.

SIPs for $PM_{2.5}$ nonattainment areas were scheduled for submittal in early 2008. U.S. EPA will promulgate area designations for the recently tightened 24-hour $PM_{2.5}$ standard in 2010. Nonattainment areas will submit SIPs in early 2013. Meanwhile, actions taken to reduce ozone, PM_{10}, and diesel PM will also help in reducing $PM_{2.5}$.

Figure 1-10

Carbon Monoxide - State Area Designations

Currently, there are no areas in the State that exceed the State CO standards. The City of Calexico, in Imperial County, was the last area with concentrations exceeding the standards.

California has made tremendous progress in reducing CO concentrations in the last 12 years, during which a number of areas were redesignated as attainment. Most recently, the City of Calexico was redesignated as attainment. Los Angeles County was also redesignated as attainment in early 2005. Much of the progress in reducing ambient CO is attributable to motor vehicle controls and the introduction of cleaner fuels.

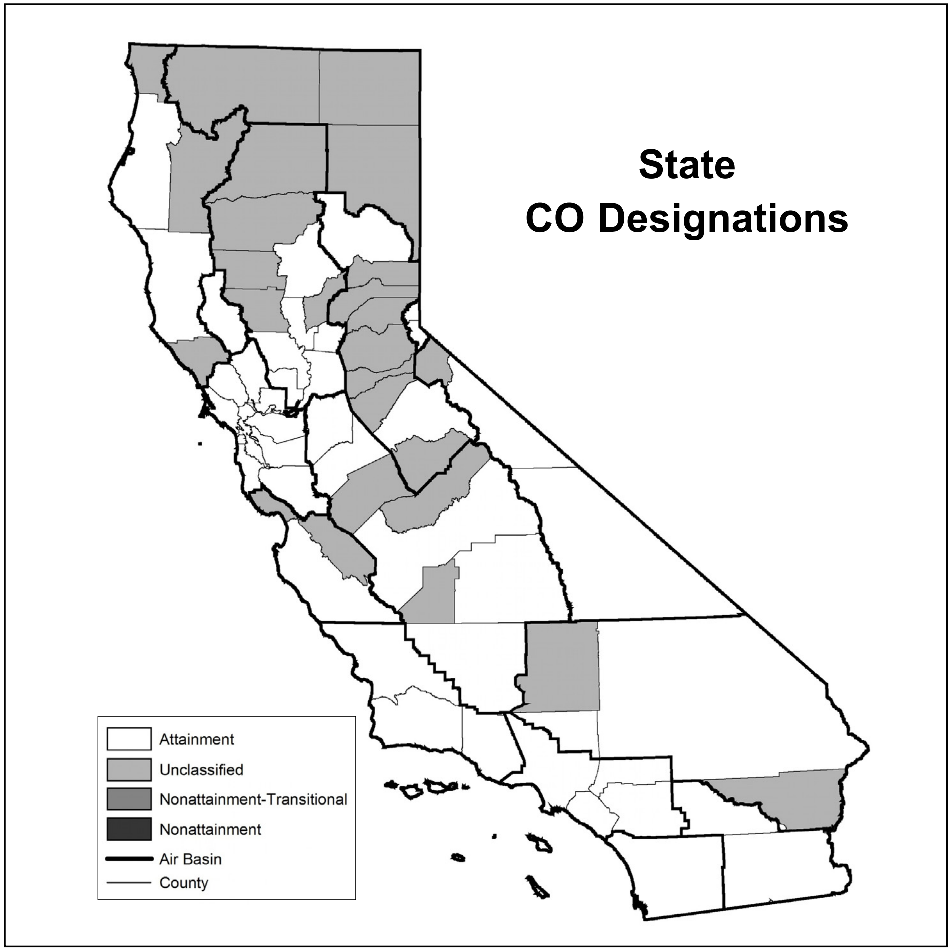

Figure 1-11

Carbon Monoxide - National Area Designations

The U.S. EPA uses only two designation categories for CO: attainment/unclassified and nonattainment. All areas of California are currently designated as attainment/unclassified for the national CO standards. The South Coast Air Basin was the final area to meet the requirements for attainment, and the U.S. EPA redesignated the South Coast as attainment effective June 11, 2007.

Most CO is directly emitted by cars and trucks, and the ARB's motor vehicle controls should be sufficient to continue controlling the problem in the coming years.

Figure 1-12

Toxic Air Contaminants

A toxic air contaminant or TAC is defined as an air pollutant which may cause or contribute to an increase in mortality or serious illness, or which may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air. However, their high toxicity or health risk may pose a threat to public health even at very low concentrations. In general, for those TACs that may cause cancer, there is no concentration that does not present some risk. In other words, there is no threshold level below which adverse health impacts are not expected to occur. This contrasts with the criteria pollutants for which acceptable levels of exposure can be determined and for which the State and federal governments have set ambient air quality standards.

The ARB's TAC program traces its beginning to the criteria pollutant program in the 1960s. For many years, the criteria pollutant control program has been effective at reducing TACs since many volatile organic compounds and PM constituents are also TACs. During the 1980s, the public's concern over toxic chemicals heightened. As a result, citizens demanded protection and control over the release of toxic chemicals into the air. In response to public concerns, the California legislature enacted a 1983 law governing the release of TACs into the air. This law charges the ARB with the responsibility for identifying substances as TACs, setting priorities for control, adopting control strategies, and promoting alternative processes. The ARB has designated almost 200 compounds as TACs. Additionally, the ARB has implemented control strategies for a number of compounds that pose high health risk and show potential for effective control.

The majority of the estimated health risk from TACs can be attributed to a relatively few compounds, the most important being PM from diesel-fueled engines (diesel PM). In addition to diesel PM, benzene and 1,3-butadiene are also significant contributors to overall ambient public health risk in California.

Diesel PM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances. Although diesel PM is emitted by diesel-fueled internal combustion engines, the composition of the emissions will vary depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emission control system is present. Unlike the other TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. Details on the method and the resulting estimates for individual air basins can be found in the ARB report entitled: *"Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant -- Appendix III Part A Exposure Assessment,"* (April 1998). Currently, the diesel PM estimates are being reviewed to reflect control measures that were outlined in the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* (October 2000).

Chapter 5 and Appendix C include information for ten TACs: acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel PM. These ten compounds pose the greatest known ambient risk based on air quality data, or concentration estimates in the case of diesel PM. The data are summarized for the State as a whole, for each of the five major air basins, and for each individual site within these air basins. Chapter 5 also discusses dioxins, based on available data. Note that other TACs may pose significant health risks, but sufficient air quality data are unavailable for these compounds.

Most of the TAC data in this almanac were obtained from monitors operated by the ARB. The majority of the information is presented on a pollutant-by-pollutant basis, with a focus on cancer risk. The available data represent average population exposures and may not represent the health risk near local sources. Localized impacts may involve exposure to different TACs or to higher or lower concentrations than those represented by the ambient monitoring data. ARB participated in several studies to address localized impacts and community health issues to learn which communities are the most impacted and who in those communities are the most vulnerable. More information on these studies is available on the web at *www.arb.ca.gov/ch/ch.htm*.

Since Statewide TAC monitoring started in 1989, the ARB has substantially increased its knowledge about TACs, and the data indicate that control efforts have been effective in reducing public exposures and associated health risks. The future gradual phase-in of control strategies will likely continue to result in lower exposures for California's citizens. In the interim, work continues on identifying toxic substances and developing a better understanding of the risks they pose. Health experts still have only a limited knowledge of the mechanisms by which many toxic substances harm the body, and there is still much work to be done in researching health effects and quantifying cancer risks. Cooperative strategies between the ARB, businesses, and other State, local, and federal agencies will be a major focus of future control efforts.

Additional information on TACs may be found on the ARB website at *www.arb.ca.gov/toxics/toxics.htm*. Detailed information on the health effects of these pollutants, as well as many other TACs, can be found in a report entitled: *"Toxic Air Contaminant Identification List-Summaries."* This report, dated September 1997, is available from the ARB Public Information Office and on the web at *www.arb.ca.gov/toxics/tac/intro.htm.*

Figure 1-13

Climate Change

The earth's climate has been warming for the past century. It is believed that this warming trend is related to the release of certain gases, commonly referred to as "greenhouse gases", into the atmosphere. The greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons. Climate research has identified other greenhouse agents that can drive climate change, particularly tropospheric ozone and atmospheric aerosols (particles containing sulfate, black carbon or other carbonaceous compounds).

Greenhouse gases absorb infrared energy that would otherwise escape from the earth. As the infrared energy is absorbed, the air surrounding the earth is heated. An overall warming trend has been recorded since the late 19th century, with the most rapid warming occurring over the past two decades. The 10 warmest years of the last century all occurred within the last 15 years, and it appears that the decade of the 1990s was the warmest in human history.

It is a fact that human activities have increased the atmospheric abundance of greenhouse gases. There are uncertainties as to exactly what the climate changes will be in various local areas, and what the effects of clouds will be in determining the rate at which the mean temperature will increase. There are also uncertainties associated with the magnitude and timing of other consequences of a warmer planet: sea level rise, spread of certain diseases out of their usual geographic range, effect on agricultural production, water supply, sustainability of ecosystems, increased strength and frequency of storms, extreme heat events, air pollution episodes, and the consequence of these effects on the economy. Already, some of these effects have been seen in California.

The United States has the highest emissions of greenhouse gases of any nation on Earth. California's transportation sector is the single largest contributor of GHGs in the State. In the absence of controls, the State's inventory of greenhouse gases would mirror the growth in population. Transportation and land use trends in California would continue to increase greenhouse gas production.

California has been studying the impacts of climate change since 1988, when the legislature approved AB 4420. This legislation directed the California Energy Commission (CEC), in consultation with the ARB and other agencies, to study the implications of global warming on California's environment, economy, and water supply. The CEC was also directed to prepare and maintain the State's inventory of GHG emissions. More information on the CEC's climate change activities can be found on the web at *www.energy.ca.gov/global_climate_change*.

In 2002, recognizing that global warming would impact California, the legislature approved AB 1493. This bill directed the ARB to adopt regulations to achieve the maximum feasible and cost-effective reduction of greenhouse gas emissions from motor vehicles. ARB staff's proposal implementing these regulations was approved by the ARB in September 2004. These regulations will be reviewed and may be modified by the California Legislature. More information on ARB's Climate Change regulations can be found on the web at *www.arb.ca.gov/cc/cc.htm*.

AB 1803 was approved in 2006. This bill directed the ARB to prepare, adopt and update the greenhouse gas emission inventory formerly required to be adopted and updated by the CEC. Also approved was the California Global Warming Solutions Act of 2006 (AB 32). Among the several new responsibilities for ARB is the requirement to establish the 1990 GHG emissions level as a limit to be achieved by 2020. At the Board Meeting held in December 2007, the Board adopted a regulation for the mandatory reporting of greenhouse gas emissions. The Board also approved the 1990 GHG emissions level equivalent to the 2020 emissions limit. More information on ARB's greenhouse gas inventory can be found on the web at *www.arb.ca.gov/cc/ccei.htm*.

California Air Quality Regulation

The responsibility for controlling air pollution in California is shared between 35 local air districts, the ARB, and the U.S. EPA. The basic responsibilities of each of these entities are outlined below.

District Responsibilities:

- Control and permit industrial pollution sources (such as power plants, refineries, and manufacturing operations) and widespread area-wide sources (such as bakeries, dry cleaners, service stations, and commercial paint applicators).
- Adopt local air quality plans and rules.

Air Resources Board Responsibilities:

- Establish State ambient air quality standards.
- Adopt and enforce emission standards for mobile sources (except where federal law preempts ARB's authority), fuels, consumer products, and TACs.
- Provide technical support to the local districts.
- Oversee local district compliance with State and federal law.
- Approve local air quality plans and submit SIPs to U.S. EPA.

United States Environmental Protection Agency Responsibilities:

- Establish national ambient air quality standards.
- Set emission standards for mobile sources, including those sources under exclusive federal jurisdiction (like interstate trucks, aircraft, marine vessels, locomotives, and farm/construction equipment).
- Oversee State air programs as they relate to the Federal Clean Air Act.
- Approve SIPs.

List of Air Pollution Contacts

Amador County Air Pollution Control District
All of Amador County
(209) 257-0112
www.amadorapcd.org

Antelope Valley Air Quality Management District
Northeast portion of Los Angeles County
(661) 723-8070
www.avaqmd.ca.gov

Bay Area Air Quality Management District
All of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara counties, western portion of Solano County, and southern portion of Sonoma County
(415) 749-5000
www.baaqmd.gov

Butte County Air Quality Management District
All of Butte County
(530) 891-2882
www.bcaqmd.org

Calaveras County Air Pollution Control District
All of Calaveras County
(209) 754-6504
www.co.calaveras.ca.us/departments/env.asp

Colusa County Air Pollution Control District
All of Colusa County
(530) 458-0590
www.colusanet.com/apcd

El Dorado County Air Quality Management District
All of El Dorado County
(530) 621-6662
www.co.el-dorado.ca.us/emd/apcd

Feather River Air Quality Management District
All of Sutter and Yuba counties
(530) 634-7659
www.fraqmd.org

Glenn County Air Pollution Control District
All of Glenn County
(530) 934-6500
www.countyofglenn.net/air_pollution_control

Great Basin Unified Air Pollution Control District
All of Alpine, Inyo, and Mono counties
(760) 872-8211
www.gbuapcd.org

Imperial County Air Pollution Control District
All of Imperial County
(760) 482-4606
www.imperialcounty.net

Kern County Air Pollution Control District
Eastern portion of Kern County
(661) 862-5250
www.kernair.org

Lake County Air Quality Management District
All of Lake County
(707) 263-7000
www.lcaqmd.net

Lassen County Air Pollution Control District
All of Lassen County
(530) 251-8110
lassenag@psln.com

Mariposa County Air Pollution Control District
All of Mariposa County
(209) 966-2220
www.mariposacounty.org/healthdepartment

Mendocino County Air Quality Management District
All of Mendocino County
(707) 463-4354
www.co.mendocino.ca.us/aqmd

Modoc County Air Pollution Control District
All of Modoc County
(530) 233-6419
apcd@modoccounty.us

Mojave Desert Air Quality Management District
Northern portion of San Bernardino County and eastern portion of Riverside County
(760) 245-1661
www.mdaqmd.ca.gov

Monterey Bay Unified Air Pollution Control District
All of Monterey, San Benito and Santa Cruz counties
(831) 647-9411
www.mbuapcd.org

North Coast Unified Air Quality Management District
All of Del Norte, Humboldt, and Trinity counties
(707) 443-3093
www.ncuaqmd.org

Northern Sierra Air Quality Management District
All of Nevada, Plumas, and Sierra counties
(530) 274-9360
www.myairdistrict.com

No. Sonoma County Air Pollution Control District
Northern portion of Sonoma County
(707) 433-5911
nsc@sonic.net

Placer County Air Pollution Control District
All of Placer County
(530) 745-2330
www.placer.ca.gov/air.aspx

Sacramento Metro Air Quality Management District
All of Sacramento County
(916) 874-4800
www.airquality.org **or** *www.sparetheair.com*

San Diego County Air Pollution Control District
All of San Diego County
(858) 586-2600
www.sdapcd.org

San Joaquin Valley Air Pollution Control District
All of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties and western portion of Kern County
(559) 230-6000
www.valleyair.org

San Luis Obispo County Air Pollution Control District
All of San Luis Obispo County
(805) 781-5912
www.slocleanair.org

Santa Barbara County Air Pollution Control District
All of Santa Barbara County
(805) 961-8800
www.sbcapcd.org

Shasta County Air Quality Management District
All of Shasta County
(530) 225-5674
www.co.shasta.ca.us/Departments/Resourcemgmt/drm/aqmain.htm

Siskiyou County Air Pollution Control District
All of Siskiyou County
(530) 841-4029
www.co.siskiyou.ca.us/agcomm/airpollution.htm

South Coast Air Quality Management District
Los Angeles County except for portion covered by Antelope Valley APCD, all of Orange County, western portion of San Bernardino County, and western and central portions of Riverside County
(909) 396-2000
www.aqmd.gov

Tehama County Air Pollution Control District
All of Tehama County
(530) 527-3717
www.tehcoapcd.net

Tuolumne County Air Pollution Control District
All of Tuolumne County
(209) 533-5693
www.tuolumnecounty.ca.gov

Ventura County Air Pollution Control District
All of Ventura County
(805) 645-1400
www.vcapcd.org

Yolo-Solano Air Quality Management District
All of Yolo County and eastern portion of Solano County
(530) 757-3650
www.ysaqmd.org

Milestones in California's Emission Control Programs

Historical Milestones:

1963: First vehicle emission control in the country – positive crankcase ventilation required to reduce evaporative emissions.

1966: First tailpipe emission standards for hydrocarbons (HC) and carbon monoxide (CO).

1971: First oxides of nitrogen (NO_x) standards for cars and light trucks.

1973: First heavy-duty diesel truck standards.

1975: Two-way catalytic converters first used to control HC and emissions from cars.

1976: "Unleaded" gasoline first offered for sale, with reduced lead levels.

Three-way catalyst first used to control NO_x, HC, and CO emissions from cars.

1984: California Smog Check program implemented to identify and repair ineffective emission control systems on cars and light-trucks.

1988: California Clean Air Act enacted, setting forth the framework for meeting State ambient air quality standards.

1992: California's reformulated gasoline introduced – reducing evaporative emissions, phasing out lead in gasoline, and requiring wintertime oxygenates to reduce CO formation.

First consumer product regulations take effect, regulating HC emissions from aerosol antiperspirants and deodorants.

1993: Cleaner diesel fuel launched, reducing emissions of diesel PM, sulfur dioxide, and NO_x.

Regulations to limit HC emissions from consumer products such as hairspray, windshield washer fluid, and air fresheners take effect.

1994: Low emission vehicle regulations to further reduce emissions from cars and light trucks take effect.

1996: Cleaner burning gasoline debuts with emission benefits equivalent to removing 3.5 million cars from California roads.

Regulations reducing HC emissions from spray paint take effect.

1998: Tighter standards for California diesel trucks and buses take effect.

Revamped Smog Check II program implemented.

1999: ARB acts to phaseout MTBE in gasoline.

2000: Tighter emission standards for off-road diesel equipment, such as tractors and generators, take effect nationwide.

More stringent California standards for the small engines used in lawn and garden equipment take effect.

ARB enacts Diesel Risk Reduction Plan.

2001: First California standards for large spark ignition off-road engines such as forklifts and pumps take effect.

More stringent standards for pleasure boats and personal watercraft sold in California begin.

Limits on HC emissions from products such as carpet and upholstery cleaners take effect.

2002: Emission standards for new heavy-duty diesel trucks are cut in half, nationwide.

2003: New emission standards for inboard marine engines sold in California take effect.

2004: Regulations to further reduce emissions from cars (and require light-trucks and sport-utility vehicles to meet the same emission standards as cars) take effect in California.

MTBE in California gasoline is fully phased out.

Tighter standards for on-road motorcycles begin.

2005: Limits on HC emissions from paint removers take effect.

2006: Low sulfur diesel fuel required nationwide.

Regulations requiring cleaner fuels in locomotives take effect.

Goods Movement emission reduction plan adopted.

2007: Tighter emission standards for heavy-duty diesel trucks take effect nationwide.

Regulations requiring cleaner fuels in ship auxiliary engines and cleaner port-side equipment take effect.

1990 Greenhouse Gas Emission Inventory and mandatory reporting requirements adopted by ARB.

Upcoming Milestones:

2009: Greenhouse gas emission standards for passenger cars and light trucks.

2011: Tighter emission standards for off-road diesel equipment.

Web Resources (www.arb.ca.gov/californiaalmanac)

Much of the information used to develop the Almanac is accessible through a variety of databases and tools available on the ARB website at *www.arb.ca.gov/californiaalmanac*.

Data

Real-time Air Quality Data - Air Quality and Meteorological Information System (AQMIS2) - Allows access to near real-time air quality and meteorological data. These data are available in tabular summary reports.

Historical Air Quality Data - Aerometric Data Analysis and Management System (iADAM) - Allows access to historical data (data for record) in tabular summary reports or displayed as graphs.

Emission Inventory Data - Allows access to historical and projected emissions, vehicle activity, and human population. Data are available for 2006, as well as for the years 1975-2020 at five year intervals.

Facility Search Engine - Allows users to locate criteria or toxics emissions data for a specific facility.

Top 25 Source Categories - Provides users with emissions for the top 25 highest emitting source categories by geographic area.

Community Level Emissions - Community Health Air Pollution Information System (CHAPIS) - Allows users to query and view emissions using a map interface.

Toxics Emission Factors - California Air Toxics Emission Factor database (CATEF) - Provides over 2000 emission factors to estimate toxic air emissions for specific industrial processes or emissions.

Information

Area Designations - Provides information regarding the designation of areas in California with respect to the State ambient air quality standards.

Air Quality Standards - Provides information on State and national air quality standards.

Central California Air Quality Studies (CCAQS) - Comprises two studies with the goal of providing an improved understanding of PM and visibility in central California.

Climate Change - Information regarding ARB's Climate Change Program.

Goods Movement Plan (GMP) - Presentation materials and policy information on California's Goods Movement Plan.

Community Health - Provides information on Community Health progams in place.

Air Quality Data Monitoring Sites - Air monitoring web site with access to the most recent quality assurance information on any particular air monitoring site. This information consists of pollutants monitored, location, operation information, and photos of the site, if available.

Transport - Information on the movement of ozone and ozone precursors between basins or regions and established mitigation requirements.

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